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XXXIII.—*Notes on Filigerous Green Infusoria of the Island of Bombay.* By H. J. Carter, F.R.S. &c.

[Plate XVII. figs. 10–24.]

Many species of *Euglena* have been described, and allusion made to their occasionally tessellate-encysted and frond-like forms, but in no previous instance, I think, has the cyst been shown to present a trumpet-shaped extension like the following, which peculiarity, more than anything in the *Euglena* itself, seems sufficient to entitle it to a distinct appellation.

Euglena tuba, mihi.

Active state.—Fusiform, cylindrical, fish-shaped; obtuse anteriorly, where it terminates in the so-called double lip and single cilium; posteriorly terminating in a short, pointed, transparent caudal prolongation. Eye-spot, contracting vesicle, nucleus, and general contents the same as in *Euglena viridis*, Ehr. (Pl. XVII. fig. 13).

Encysted state.—Cyst gelatinous, globular, transparent, colourless, with polar elongations corresponding to the anterior and posterior extremities of the *Euglena*: posterior one short, pointed, closed; anterior one extended into a tubular prolongation, which ends in an open trumpet-shaped expansion. Size of body of largest cyst 1-600th of an inch in diameter; tubular extension of equal length (figs. 10–12).

Hab. Fresh water, spreading by division, during encystment, over the surface of the water in a deep quarry-pit tank, in the island of Bombay, throughout the dry season. Forming frond-like aggregations, one cell deep, united net-like by constricted portions, and surrounded generally by a soft gelatinous envelope; finally extending over the whole of the tank, to whose surface it imparts a more or less ferruginous tint, arising

from the increasing red colour of the contents of the *Euglenæ* generally (fig. 10).

Obs. The peculiarity of this *Euglena*, as before stated, consists entirely in the trumpet-shaped extension of the cyst (11 *a*), which, no doubt, allows the cilium to play freely in the water beneath, probably for aëration and nutriment during the time that the *Euglena* is multiplying itself in the way above mentioned. I observed this phenomenon for two successive years, in the deep tank formed out of an old quarry in the trap-rock of the garden of the Hope Hall hotel at Bombay, where the brilliant red colour which it presented was most remarkable. There did not appear to be any rule for the commencement or extension of the process of reddening in the chlorophyll; for sometimes it began in the middle, sometimes at one end, and sometimes at the other, of the *Euglena*.

Euglena agilis, Cart. (Ann. ser. 2. vol. xviii. pl. 6. fig. 62, *a–d*).

So named from its active movements. It is further characterized by its flask-like form, the enlarged end being posterior; by its double spherical nucleolar cell, and its short, blunt, caudal prolongation when this is present, which is not always; also by its remarkable tendency to multiply itself both in the active and passive or encysted state—that is to say, dividing longitudinally or transversely in the former, and crucially and linearly in the latter, the linear division resulting in short filament-like forms, in which each cell has an eye-spot. Add to this its brackish-water habitat in the island of Bombay.

I ought to have given this detail with my figure in the 'Annals' of 1856, vol. xviii., as the remark in the last edition of Pritchard's 'Infusoria' (1861) justly indicates. Hence its publication now.

Uvella bodo, Ehr.

Those who are acquainted with the great tribe of green filigerous Infusoria, of which *Euglena viridis* is at once the commonest and most beautiful type, are aware that the course of individual increase, both with and without the true process of generation, in this tribe is effected by division of the cell-contents, within the cell, into a greater or less number of parts.

In the true process of generation, the division for the female element ceases while the divided portions are yet large, but goes on to a more or less minute degree for the spermatic element, when the two, afterwards meeting under favourable circumstances (that is, while both the elements are still plastic, and neither surrounded by a *closed* cellulose wall), complete the

first step towards the performance of the mysterious function. That is to say, the contents of the original cell undergo more or less dividing into a greater or less number of parts for the multiplication of individuals by each process.

Now, when the original cell yields to the internal pressure so caused, and its divided contents are thus liberated into the water, they may, under abnormal or abortive circumstances, continue for a longer or shorter time more or less grouped together before they ultimately separate, and in this state, collectively or individually, assume forms so different from the original cell that they have in many instances received different names for their different phases, as though they had been distinct species. *Uvella bodo* appears to me to be one of these.

This extended nomenclature does not matter so long as the names are known to apply to the parts of a species otherwise indicated; indeed they are as necessary as convenient. Hence I do not hesitate to describe the following phase under the name given to it by the illustrious microscopist of Berlin.

Uvella bodo (Ehr. tab. 1. fig. 21, 'Infusionsthierchen').—Conical, grouped in the form of grapes, green. Anterior extremity obtuse, provided with a bunch of many cilia, which project forwards from the centre; posterior extremity acute; general surface presenting the pointed ends of the cells which compose the mass. Cells sixteen in number, developed upon a central or axial cavity, which is conical; each cell pyriform, of a deep-green colour, fixed by its obtuse end to the central cavity, and having its pointed one free and floating backwards; monociliated, with red eye-spot; contracting vesicle and contents of the body generally consisting of protoplasm charged with chlorophyll, nucleus, and sundry granules. Size of the largest group observed (viz. that figured) 1-415th inch long by 1-540th broad; individual cell 1-900th inch long by 1-1800th broad (fig. 14).

Hab. Island of Bombay, in shallow freshwater pools which soon dry up after the cessation of the rainy monsoon, from June to August inclusive; in company with almost the whole tribe of green filigerous Infusoria. Progression oscillatory, with the large end of the group foremost.

Obs. I have often seen *Uvella bodo*, and as often figured and described it, in the months mentioned, always thinking that, as Ehrenberg's figure did not by any means portray sufficiently this beautiful organism, I would one day attempt to supply the deficiency. The groups vary greatly in size; and the cilia sometimes float backwards between the caudal extremities of the cells, as well as project in front of the group;

sometimes, indeed, I have not been able to see them at all in front. But in none of my figures is the individual cell represented with more than one cilium; and the sketch which beyond all others bears under it the term "correct" is that now chiefly described and figured.

On this occasion, too, there were large, elliptical, unciliated cells present, measuring 1-675th inch long by 1-1080th broad, containing thirty-two cells; but the cells so formed and so arranged are altogether so like *Uvella bodo* that, although the division had gone one degree further, and they were still enclosed in the parent deciduous envelope or cell, there can be little doubt that they were respectively so many groups of *Uvella bodo*, which, on being liberated, would have assumed the same characters, only in the 32- instead of the 16-cell form. It is worthy of remark, too, that there was an indication of a tail to this cell (fig. 15 *a*).

Finally, the last note, with a figure, which I possess on the subject runs as follows:—

"June 11, 1861. Found the 16-cell *Uvella bodo* numerous with *Eudorina elegans*. There seems to be very little doubt that it is nothing more than one of the forms assumed by the 16-cell packets of young *Eudorinæ*. The different sizes of the groups, the central cavity or elongated central cell upon which the green cells of the *Uvella* are fixed (fig. 14 *b*), and their general development, altogether favour the view now taken. I never thought that it was a distinct species or organism. When the tails are very short, rendering the cells almost round, it is close upon a 16-cell *Eudorina*. There is no other green organism in the water (which is from a little temporary pool) with the *Eudorina* but *Uvella bodo* and the other forms of *Eudorina*-packets, viz. *Gonium pectorale* &c."

This observation seems to indicate that *Uvella bodo* is at least one of the forms assumed by the cells of *Eudorina* when they divide up into the 16- and 32-cell groups respectively.

But, to return to the one which I have figured and more particularly described: this, as before stated, was accompanied by a whole host of filigerous green Infusoria, among which were many kinds of *Euglena*; while the eye-spot (and this is essential) was at the base of the cilium, which was also single in each individual of the group (fig. 14 *d*), at the same time that there were other groups of *Uvella bodo* present still unliberated from the parent cell, which, be it remembered, had a kind of tail or caudal prolongation (fig. 15 *a*). Hence *Uvella bodo* here appeared to have been derived from a subdivision of the contents of a *Euglena* like *E. viridis*, and not from a cell of *Eudorina*, which has two cilia, two contracting vesicles at

their base, and an eye-spot *laterally* placed—that is, away from the contracting vesicles and cilia.

In the division of the cell-contents of the green filigerous Infusoria, the eye-spot is at first seldom so well marked in the daughter or subdivision cells which are inferior as in those which are superior or close to the eye-spot in the parent. Indeed it is frequently absent altogether in the former, while it may be markedly present only in the latter, as in my figure of *Uvella bodo* (fig. 14 *d*); but although, when not visible, it may, in point of position, lead to doubt as to the organism to which the cell belongs, when it is at the base of the cilium the cell certainly appertains more to *Euglena* than to *Eudorina*, *Volvox*, or *Chlamydococcus*, wherein the eye-spot is lateral, and not anterior or terminal (figs. 22 & 24).

Again, the *single* cilium is more typical of *Euglena* than of either *Eudorina*, *Volvox*, or *Chlamydococcus*, in each of which it is dual. At the same time it should also be noted that, in the still forms or passive state of each of the latter, the cilia appear to be altogether absent—that is, deciduous or retracted, these organisms having the power to reproduce them in the active state.

Thus the *Uvella bodo* which I have figured seems more nearly allied to *Euglena* than to *Eudorina*.

It would, *now*, have been more satisfactory if in my note of 1861, where *Uvella bodo* was found almost exclusively with *Eudorina*, I had set down the number of cilia and position of the eye-spot in each member of the group. But I suppose, at the time, I saw all that was conclusive, and therefore, in the absence of this now desired detail, must present the note as it is and for what it may prove hereafter to be worth. Upon the *number*, however, of the cilia, as will presently appear, there is not much reliance to be placed.

Ehrenberg found *Uvella bodo* in company with *Euglena viridis*, *Chlorogonium euchlorum*, &c., and figures something like it in connexion with the latter (fig. 17, t. 7, *op. cit.*). Perty simply states that it "seems" to be a developmental stage of *Euglena viridis* (Zur Kenntn. klein. Lebensformen, p. 177), and Stein "that each individual appertaining to a group of *Uvella bodo* possesses several (four or five) flagelliform cilia implanted on a short rostrum" (*ap.* Clap. et Lach. 'Etudes sur les Infusoires,' &c. vol. ii. p. 63).

As above stated, I have often seen a bunch of cilia on the front part of the *group*, but never more than one cilium on the *individual*, although I think that sometimes the latter may have possessed two, and that I have overlooked this occurrence.

Crumenula texta, the Thecamonads, *Eudorina*, *Volvox*, *Chlamydococcus*, and most, if not all, the green filigerous Infusoria undergo more or less subdivision within their cells respectively, for simple multiplication or multiplication by sexual increase; and the groups of cells thus formed often continue together after having been liberated; so that each species may assume different phases, and thus each have its own *Uvella bodo*.

I have, however, never seen a subdivision of this kind in *Euglena viridis* and its like, although I can easily conceive that *its* family does not differ in this respect from the other green filigerous Infusoria; while certainly the figures of the *Uvella bodo* which I have given, both in the active and unliberated state, appear to be more nearly allied to *Euglena viridis* than to any other organism.

Volvocina.

Hereto may also be added the conclusions at which I have arrived respecting the different groups of cells figured and named by Ehrenberg as distinct organisms in connexion with *Eudorina* and the two *Volvoces*—conclusions to which long and attentive study of these Infusoria, at different times for several years successively, have brought me.

And first as regards *Eudorina elegans* (tab. 3. fig. 6, 'Infusionsthierchen'), which is represented with one cilium to each cell. I have always observed two. Of figs. 1, 2, 3, 4, 5, viz. *Gonium pectorale*, *G. punctatum*, *G. tranquillum*, *G. hyalinum*, and *G. glaucum* respectively, the first three appear to me to be all cell-group forms or phases of *Eudorina elegans*; figs. 4 & 5 seem to me to be almost too small for *E. elegans*, and, being without colour, to be groups of some other organism, if not parasiticized cells of *Eudorina*—that is, cells altered by the presence of some endophyte (Mycetozoon).

Of figs. 31 and 32, tab. 2, viz. *Gyges granulum* and *G. bipartitus*, given in connexion with *Pandorina morum* (which, as will hereafter be observed, I consider a phase of *Eudorina*), the former appears to me to be the still form of the primary cell of *Eudorina elegans*, and the latter the same under binary division. According to Perty's view, *Gyges* might be the still form of several kinds of Algæ (p. 102, *op. cit.*); but, be this as it may, a large ovoid cell like this (fig. 24), but in the active state, with four cilia projecting from its smaller end, two contracting vesicles at their base, an eye-spot lateral, and single nucleus central (parietal?), together with the usual green and granular contents, was found in abundance, with *Eudorina elegans* and *Uvella bodo*, in a recent excavation of the trap-

rock in the island of Bombay, on the 17th June 1861, some days after the rainy monsoon had commenced and this excavation had become filled with rain-water. Size of the cell 1-981th inch long by 1-1350th broad.

In some of these cells the single nucleus had been replaced by several, as if preparatory to subdivision; while in others there were a great number of contracting vesicles scattered throughout the cell-contents for the same purpose, if they did not belong to parasitic cells (endophytes) otherwise invisible. Lastly, some of these cells were observed to be encysted binarily as in *Gyges bipartitus*, and some quaternarily, but not further; at the same time each subdivision was observed to be provided with four cilia within its compartment respectively.

And here my observations of this cell would have ended, had there not also been binary compounds present, where one of the 4-ciliated cells had been arrested in its further development, while the other had become subdivided into the 16-cell form, each cell of which was attached to the transparent globular capsule enclosing the whole, with the *two* cilia of each cell projecting externally and all widely separated, as in *Eudorina*. (I regret that there is not room in the plate for a figure of this; but probably I may have an opportunity of supplying it hereafter.)

Thus the transparent capsule was studded over with the subdivisions of one of the 4-ciliated cells on one side; while in the other the 4-ciliated cell remained undivided, with its contents shrunken and retracted from its own cell-wall (probably owing to the poisonous presence in it of some endophyte).

Hence I inferred that this 4-ciliated cell, which somewhat resembled *Gyges*, was the primary active cell of *Eudorina elegans*, viz. that stage which, when my figures and description of *Eudorina* under impregnation were published (Annals, vol. ii., Oct. 1858), I was not able to supply.

Add to this evidence the fact that for four successive years, in the months of June and July respectively, the same ovoid cell precisely stands figured in my journal, in connexion with *Eudorina elegans*, obtained in abundance and under almost all forms from different pools of water widely separated.

An ovoid 4-ciliated cell, such as I have above described, then, appears to be the primary active cell or sporozoid of *Eudorina*.

So far as my observation extends to the *Chlamydococcus*, also figured with *Eudorina* (*op. et loc. cit*), its subdivisions, even when still more numerous than there shown, remain free and entirely *within* the parent capsule, whereas in both *Eudo-*

rina and the *Volvoces* the divisions are fixed to the inner surface of the parent cell, with their two cilia projecting externally, affording still further probability that the 4-ciliated cell is the primary phase of *Eudorina*.

Cells of this kind with *four cilia* are very common both in fresh and salt water; and thus the ciliated character is of less consequence than the form and size of the cell itself, which varies much, and perhaps may be found indicative in many instances of the species of which it may be the sporozoid.

It may be also a question whether the ovoid cell which I have just described may not sometimes assume a different form; for on one occasion I find figured with it a spherical one, but identical with the ovoid one in size and all other respects.

Still, be this, too, as it may, we shall never know anything definitively about these forms, or the species to which they respectively belong, until they are all brought together into their respective groups; for then, and then only, shall we be able to clear up the utter confusion of phasial differences which may exist in even one drop of water, in this department of the filigerous Infusoria.

Perty places the 4-ciliated cells among his "Sporozoidia" (p. 102), and figures an oval one (tab. 10. fig. 9) with a notch in front, but with no red eye-spot, which he likens to *Chlamydomonas*. He also, as before stated, likens Ehrenberg's *Gyges* to the latter. Lastly, Cohn (*ap.* Pritchard, p. 524, ed. 1861) considers *Gyges* to be the still form of a cell of *Protococcus*. But, whatever *Gyges* may be, Ehrenberg's figures of it are naturally so meagre that further conjecture respecting them becomes useless.

Of what value, it may now be asked, is the number of cilia characteristically, when, as we have just seen, the *small* subdivisions of a 4-ciliated cell are only provided with two cilia each? Certainly it does not militate against the view that the 2-ciliated *Eudorina*-cell does not originally arise from the *small* subdivisions of the 4-ciliated one. Moreover the 4-ciliated cell is the sporozoid of several filamentous Algæ, which, of course, have no cilia as such, any more than the still forms of the unicellular Algæ.

To return to our subject of the phasial forms of *Eudorina* in Ehrenberg's plate 2. figs. 33 & 34, viz. *Pandorina morum* and *P. hyalina*, both appear to me to be large parasiticized cells of *Eudorina*. The first represents the cells of *Eudorina* under different degrees of subdivision, and the latter where they have passed into the spermatoid condition. Here, again, there is only one cilium. I think there should be two.

Lastly, Perty's *Synaphia Dujardinii* (fig. 8 G, tab. 11) ap-

pears to me to be that abnormal form of *Eudorina elegans* where several of the cells here and there take on the spermatoid development while the rest become abortive. In the normal form of *Eudorina* it is only the four anterior cells which are developed into spermatozoids, while the rest remain all female cells (see Annals, *l. c.*). Besides, Perty's description of the cells generally and individually which form the groups, his figures, too, of their subdivisions, and, lastly, his placing this form in his family "Volvocina" lead me to the above inference. The gelatinous envelope of *Synaphia* is common to many cells of this kind under similar conditions, but persistent in none.

As regards the *Volvoces*, *Volvox aureus* (fig. 2, tab. 4, Ehr. Infus.) appears to me to be *V. globator* after impregnation of the spore-cells, or with parasites in the spore-cells causing the chlorophyll to become yellowish. Fig. 11, tab. 3, *Uroglena volvox*, represents the small or spermatic cell, which, having passed into spermatozoa, has become liberated from the parent, but still swims about entire in an abortive form or monstrosity. Fig. 8, tab. 3, *Sphærosira volvox*, is the male cell of *V. globator* (which is dicecious), with most of the spores passing into spermatozoa. Fig. 7, tab. 3, viz. *Syncrypta volvox*, appears to me to be spermatic cells of *Volvox* in different degrees of division, in the 4, 16, and 64 divisions; but of this I am not quite certain. Fig. 9, tab. 3, *Synura uvella*, appears to be another form of the divided spermatic cell of *V. globator*, in which the spermatozoa are fully formed and have more or less left the cell, to which their tails still adhere.

Such is the result of my study of *Eudorina* and the two *Volvoces* at different times, in water taken from pools which swarmed respectively with these three Infusoria, both in their normal and abnormal forms, the latter representing normal forms in stages of development which, having from some cause or other failed of their object, have assumed abortive or abnormal dimensions, since, as before stated, if the male and female elements of generation do not come together quickly in their plastic state, they are soon surrounded by a layer of cellulose, which, although it does not lead immediately to their death, prevents them in most instances from fulfilling their purpose; and thus living on for a certain time, they grow into monstrosities, which nevertheless after this manner represent so many phases of the species to which they belong; while the true type of the latter can only be established by the presence in it, monœciously or dicœciously, of the elements of generation.

The general cell in *Eudorina elegans* (Ann. *l.c.*) is *elliptical*, almost the same as that represented by the sporozoid which I

have inferred to be its primary active form, the resting impregnated spore being probably spherical, as it is when undergoing impregnation (see fig. Ann. *l. c.*) in the well-known elliptical figures of *Eudorina*.

The cell of *Volvox globator*, which is diœcious, is *spherical*; and the cell of *V. stellatus* is obtusely *elliptical* (see Annals, *loc. cit.*).

To these three species respectively I conceive the whole of the forms in Ehrenberg's 3rd and 4th plates, together with figs. 31 to 36, in plate 2, inclusive, to belong.

I think that a German naturalist has already witnessed and described the development of one of the *Volvocina* from the resting-spore; but my means of reference are now too limited to enable me to find out this more satisfactorily.

Glenoclosterium, nov. gen.

Glenoclosterium varians, n. sp.

Cell-wall fusiform, spindle-shaped, elongated, acuminated, transparent. Body more or less inflated and more or less confined to the centre, filled with protoplasm, granules, and chlorophyll; presenting a nuclear cell in the centre, a red eye-spot at one end, and four or more large chlorophyll- and starch-bearing utricles arranged longitudinally, decreasing in size from the centre towards each extremity. Extremities attenuated, pointed, colourless, transparent. Size, 1-257th of an inch long by 1-1800th broad in the centre. (Fig. 16.)

Hab. Island of Bombay; freshwater pools during the rainy monsoon; in company with *Chlamydococcus* and many other green filigerous Infusoria.

Obs. This is a very interesting form, inasmuch as it is a link between *Euglena* and *Closterium*. It has the eye-spot of *Euglena* (fig. 16 *a*), but not the cilium, and the form generally, together with the chlorophyll- and starch-bearing utricles (*b*), of *Closterium*, without its characteristic circulation. I cannot, however, help thinking that it is a form of the *Chlamydococcus* which I have already described and figured (Annals, 1858, vol. ii. pl. 8); for this species, as I may have to show hereafter, appears to be exceedingly sportive in its developments. In one instance it was found in the still form, with a conical, transparent, comet-like elongation of its cell *on one side only*, which form it maintained through all its groups and subdivisions (fig. 21). That which I have just described owes its *Closterium*-figure to this conical extension into an attenuated form being added to both sides. In fig. 17 the inflation is

almost spherical, and confined to the centre. In fig. 18 the whole form is spicular, and in fig. 19 also spicular, but bifid at one extremity. Fig. 20 represents a sigmoid form; and all appear to me to be derived from fig. 22, which is the active form of the *Chlamydococcus* that was in company with them.

No difficulty, however, can arise from my having made for the time being a separate genus for this hybrid organism, since, if hereafter it should be proved to be merely a sportive form of *Chlamydococcus*, the generic name can be erased, and the specific one alone retained for the variety. Meanwhile the record as it is may not be without its advantages in the history of this cell.

Halteria, Duj.

Halteria pulex, Clap. et Lachm. Pl. XVII. fig. 23.

This infusorium, described and figured by the eminent authors of the 'Etudes sur les Infusoires' (p. 370, pl. 13. figs. 10, 11), has always attracted my attention, from its being so exquisitely sensitive (I might almost say timid), in combination with its extreme minuteness—since the instant it comes in contact with another animalcule, it leaps backwards, with the appearance almost of instinctive fear, although it is hardly one-thousandth of an inch long, and less than this in breadth. Its body is globular, surmounted by a neck, which is inflated below (where it joins the body) by the presence of two actively contracting vesicles (*c c*), beneath which, again, is a frill of straight radiating cilia, arising from the constriction which marks the union of the neck with the body (*a*). In front the neck is truncated, supporting several short parallel straight cilia arranged brush-like—that is, all of one length, like the so-called teeth in *Chilodon* (*b*). I could see no nucleus; and both the body and neck were charged with transparent corpuscles reflecting a yellow-greenish light. Size, 1-1080th inch long (including teeth-like cilia) by 1-1800th broad.

Hab. Island of Bombay; freshwater tanks. Progression rapid, rotatory, produced by a spinning motion of the frill of cilia, which can also be used as legs for creeping; leaping here and there, especially backwards, when coming in contact with another animalcule. Anterior part of the neck and tooth-like cilia retractile.

Obs. The infusorium described and figured by the authors above mentioned as existing in salt water would hardly merit further mention, had I not often found it also in the freshwater tanks of the island of Bombay, and with two contracting vesicles, which these authors had not seen. Like these naturalists, however, I was not able to discover the nucleus.

The same doubt exists here with respect to *Halteria pulex* that accompanies the observation of many Infusoria, viz. whether or not it be the adult form of the animalcule which it represents. The presence, as before stated, of true generative elements can only decide the question. Until this be determined, all that can be said of *Halteria pulex* is that its form and habits are strikingly like those of a young podophryan *Acineta*.

EXPLANATION OF PLATE XVII. figs. 10–24.

N.B. All the figures in this Plate are drawn upon the scale of 1-12th to 1-5400th of an inch, unless where otherwise mentioned.

Fig. 10. *Euglena tuba*, n. sp. Portion of the encysted, passive, or still state, forming a red crust on the surface of the water: *a*, *Euglenæ*; *b*, trumpet-shaped cysts; *c*, general investing membrane. (Scale 1-24th to 1-5400th of an inch.) Some of the cysts have not been coloured, and the trumpet-shape tube is not added in all, for convenience.

Fig. 11. The same, more magnified, encysted: *a*, trumpet-shaped elongation of the cyst.

Fig. 12. The same, empty cyst.

Fig. 13. The same, in active state.

Fig. 14. *Uvella bodo*, Ehr. The 16-cell form: *a*, cell bearing eye-spot and contracting vesicle; *b*, dotted line showing axial cavity round which the cells individually are fixed; *c*, cilia; *d*, separate cell, showing red eye-spot, contracting vesicle, and single cilium; *e*, individual cell belonging to a group where the cilium floated backwards.

Fig. 15. The same, 32-cell form, still within the cell-wall of the parent: *a*, caudal prolongation.

Fig. 16. *Glenoclosterium varians*, nov. gen. et sp.: *a*, red eye-spot; *b*, nucleus; *c*, starch-utricles surrounded by chlorophyll, as in *Closterium* and the bands of *Spirogyra*.

Fig. 17. The same (?), with the body more confined to the centre of the cell (approaching the form of *Chlamydococcus*): *a*, red eye-spot.

Fig. 18. The same (?), assuming a spicular form; no eye-spot. Filled with chlorophyll and transparent vesicles attached to amylaceous (?) granules.

Fig. 19. The same, with bifid extremity.

Fig. 20. The same, of a sigmoid form, with central utricles, but no eye-spot.

Fig. 21. The same, with a pointed conical extension of the cell on *one side only*.

Fig. 22. *Chlamydococcus* ——? (active state), of which figs. 16–21 inclusive appear to be passive states.

Fig. 23. *Halteria pulex*, Clap. et Lach.: *a*, frill of propelling cilia; *b*, retractile cilia; *c c*, contracting vesicles. (Scale 1-6th to 1-5400th of an inch.)

Fig. 24. Primary active cell (sporozoid) of *Eudorina elegans*: *a*, red eye-spot; *b*, contracting vesicles; *c*, nucleus.